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NET AND GROSS RATES  
OF LAND CONCENTRATION

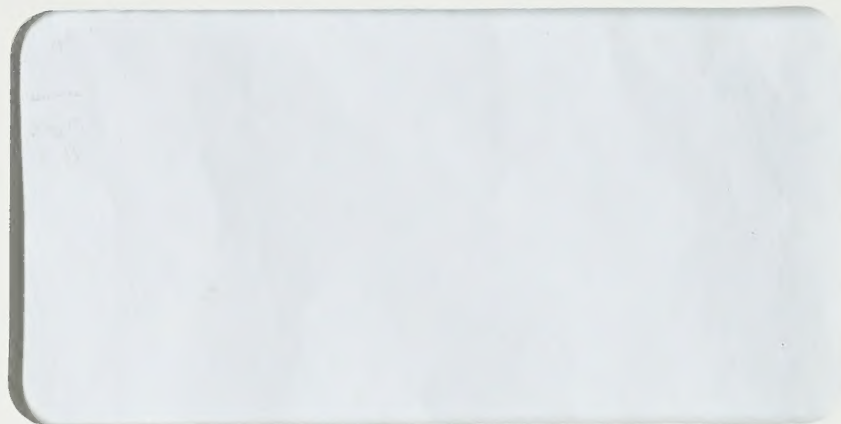
by

Ray Bollman and Philip Ehrensaft

No. 12

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**NET AND GROSS RATES  
OF LAND CONCENTRATION**

by

Ray Bollman and Philip Ehrensaft

No. 12

Social and Economic Studies Division  
Statistics Canada



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The analysis presented in this paper is the responsibility of the author and does not necessarily represent the views or policies of Statistics Canada.



## ABSTRACT

### NET AND GROSS RATES OF LAND CONCENTRATION

Average land area per farm, as one component of the structure of agriculture, is an important issue in both developing and developed countries. A reversal in the relationship between the rate of change in labour costs versus machinery costs in Canada in the last half of the 1970's helps to explain the decline in the rate of growth of farm size during this period.

There was considerable concentration of farmland in Canada as early as 1901 and this concentration has been persistently increasing over time. A simple Markov chain projection of farms by size class of acres per farm is presented using transition probability matrices averaged for three periods (1966 to 1971, 1971 to 1976, and 1976 to 1981) but the reversal in the relationship between relative labour and machinery costs in the late 1970's suggests a projection using only 1976-1981 data is more realistic.

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Key Words: concentration, structural change, farm, gross flows, entry, exit.

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## NET AND GROSS RATES OF STRUCTURAL CHANGES IN AGRICULTURE

### 1. Introduction

The structure of agricultural production can often be compressed into a discussion of average farm size in terms of land area per farm. Some agricultural units with large sales do operate on small land bases but most large operations maintain large land holdings.

Average land area per farm, as one component of the structure of agricultural production, is an important issue in both developing and developed countries. This paper will, however, be directed towards the situation in developed countries, where some of the major issues are:

1. control of agricultural production by large and sometimes non-farm corporate interests;
2. the changing within-farm social relations resulting from an increasing ratio of paid workers to unpaid family workers;
3. maintenance of a viable rural social infrastructure during periods of rural depopulation; and
4. the desire to understand probable future trends in order to be prepared for, or, possibly, to counteract future developments.

This paper will show that the Canadian trend in average acres per farm appears consistent with the model proposed by Kislev and Peterson. The recent reversal in the trend of the price of labour relative to machinery suggests, according to Kislev and Peterson, that the rate of growth of average farm sizes will decline (and may reverse!). To put the growth of farm size in perspective:

1. the change in the size distribution of farms is discussed;
2. entry rates, exit rates and mobility rates among size classes are summarized; and



3. two simple Markov chains are estimated to suggest alternative scenarios for the future size distribution of farms.

2. Net Rates of Structural Change

- 2.1 Change in Farm Size Over Time

The total land on Canadian farms peaked in 1966 at 174.1 million acres, but has varied in a narrow range between 168.0 and 174.1 million acres in the 1941 to 1981 period (Table 1).

The number of farms peaked in 1941 at 733 thousand and declined to 318 thousand in 1981. Consequently, average acres per farm has increased from 237 acres in 1941 to 528 acres in 1981.

The rate of decline in the number of the farms (and, consequently, the rate of increase of average acres per farm) has slowed from -15 percent in the 1966-1971 period to -8 percent in the 1971-1976 period to -6 percent in the 1976-1981 period.

Kislev and Peterson<sup>(1)</sup> have proposed a model wherein "99 percent of the growth in farm size as measured by acres per farm is explained by the model ... the explanation ... relied entirely on relative factor price changes rather than catchall phrases such as 'technological change' or 'economies of scale'" (pp. 592-593). The essence of their model is that the quantity of labour per farm has remained historically constant and, thus, the increase in acres per farm results from an increase in the quantity of 'mechans' (mechanical services). The increase in "mechans" represents an increase in the machinery-labour ratio, the consequence of an increase in the ratio of wages to the price of mechanical services.

The data have not been collected to verify the model in the Canadian situation. Thus, we are not presenting a test of the Kislev and Peterson

(1) Yoav Kislev and Willis Peterson, "Prices, Technology, and Farm Size", Journal of Political Economy, (1982), Vol. 90, No. 3.



TABLE 1: Number of Census-farms and Average Acres per Census-farm, Canada, 1921-1986

Year	Aggregate Acres of Farmland	Number of Census Farms	Acres per Census Farm		Aggregate Acres of Farmland	Number of Census Farms	Acres per Census Farm
					- percent change -		
1921	140,887,903	711,090	198		-	-	-
1931	163,114,034	728,623	224		15.8	2.5	13.0
1941	173,563,282	732,832	237		6.4	.6	5.8
1951	174,046,654	623,091	279		.3	-15.0	17.9
1956	173,923,691	575,015	302		-.1	-7.7	8.3
1961	172,551,051	480,903	359		-.8	-16.4	18.6
1966	174,124,828	430,522	404		.9	-10.5	12.7
1971	169,668,614	366,128	463		-2.6	-15.0	14.6
1976	169,086,823	338,578	499		-.3	-7.5	7.8
1981	162,815,073	318,361				-6.0	
1981(1)	167,985,458		528		-.7		5.7
1986	167,601,113	293,089	572		-.2	-7.9	8.4

(1) These are the 1981 "suggested" values. In 1981, unimproved land was under-reported in the western provinces. This problem was not encountered in 1986. Therefore, direct comparisons of the published estimates for 1986 and 1981 are not valid. For this reason, the 1986 data have been compared to the "1981 suggested" values which were released in a cautionary note to users subsequent to the 1981 Census.



hypothesis. The reason for referring to their study is to note the changes in a fundamental price trend. This should be an important consideration for the projections of farm numbers presented below.

One important observation, suggested by Kislev and Peterson, is that the number of individuals per farm in the agricultural industry (albeit not adjusted for quality) remained close to an average of 1.4 since 1951 (Table 2). The average varied from 1.7 to 1.8 during the 1921 to 1951 period.

Thus, with a constant amount of labour per farm, an increase in acres per farm is equivalent to an increase in acres per unit of labour. More acres per unit of labour is possible if the quantity of machinery services of 'mechans' increases relative to labour. The 'mechans' to labour ratio will increase if the ratio of labour costs to the price of 'mechans' increases.

One observes that during the decade of the largest increase in the opportunity cost of labour (proxied by the annual earnings of non-farm production workers) relative to the price of replacement machinery (this is scarcely a proxy for the price of a constant quality of machinery services), we find the largest increase in acres per farm (see the data for the 1961-1971 period in Table 3). Similarly, when the opportunity cost of labour (in the post-war period, for example) has risen less slowly compared to the price of machinery, the number of acres per farm have also risen less slowly (e.g., the 1971-1981 period).<sup>(2)</sup> Kislev and Peterson speculate that the reversal in the trend of the opportunity cost of labour relative to machine costs (Figure 2) "should stabilize and perhaps even decline" (p. 592) farm size. This possibility invites a consideration of historical trends in the concentration of farmland.

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(2) However, a regression for the 1921-1981 period of five-year observations on the percent change in average acres as a function of the ratio of labour to machinery costs (defined above) does not provide a significant relationship (see Figure 1).



Table 2. Labour, Land, and Machinery in Agriculture, Canada, 1871-1981

Year ( * ) indicates census year	Number of farms (1)	Number of individ. in agric. industry (,000) (2)	Land in agric. (,000 ac.) (1)	Average hired farm wage rate per day (without board)	Index of farm wage rates (1961 =100) (2)	Average indust. weekly wage rate (2)	Average annual earnings prodn. workers (2)	Farm mach. price index (1961 =100) (2)	Average acres per farm	Number of individ. in agric. per farm	Ratio of farm wages to mach. price index	Ratio of farm wage index to mach. price index	Ratio of indust. weekly wage to mach. price index	Ratio of annual earnings prodn. workers to mach. price index
*1871	367862	n.a.	36047	n.a.	n.a.	n.a.	n.a.	n.a.	98	n.a.	n.a.	n.a.	n.a.	n.a.
*1881	464025	n.a.	45358	n.a.	n.a.	n.a.	n.a.	n.a.	98	n.a.	n.a.	n.a.	n.a.	n.a.
*1891	542181	n.a.	60288	n.a.	n.a.	n.a.	n.a.	n.a.	111	n.a.	n.a.	n.a.	n.a.	n.a.
*1901	511073	n.a.	63422	n.a.	n.a.	n.a.	n.a.	n.a.	124	n.a.	n.a.	n.a.	n.a.	n.a.
*1911	682329	n.a.	108969	n.a.	n.a.	n.a.	417	n.a.	160	n.a.	n.a.	n.a.	n.a.	n.a.
*1921	711090	1165	140888	n.a.	32.60	n.a.	999	42.6	198	1.64	n.a.	0.765	n.a.	23.45
1922	712847	1192	143111	n.a.	28.40	n.a.	941	34.4	201	1.67	n.a.	0.826	n.a.	27.35
1923	714605	1213	145334	n.a.	29.40	n.a.	961	35.5	203	1.70	n.a.	0.828	n.a.	27.07
1924	716362	1206	147557	n.a.	28.40	n.a.	973	39.2	206	1.68	n.a.	0.724	n.a.	24.82
1925	718120	1220	149780	n.a.	28.20	n.a.	967	37.5	209	1.70	n.a.	0.752	n.a.	25.79
1926	719877	1251	152004	n.a.	29.10	n.a.	999	37.3	211	1.74	n.a.	0.780	n.a.	26.78
1927	721634	1284	154227	n.a.	29.90	n.a.	994	37.3	214	1.78	n.a.	0.802	n.a.	26.65
1928	723392	1305	156450	n.a.	29.70	n.a.	1021	37.3	216	1.80	n.a.	0.796	n.a.	27.37
1929	725149	1307	158673	n.a.	28.90	n.a.	1041	37.3	219	1.80	n.a.	0.775	n.a.	27.91
1930	726907	1238	160896	n.a.	25.70	n.a.	995	37.1	221	1.70	n.a.	0.693	n.a.	26.82
*1931	728664	1216	163119	n.a.	19.60	n.a.	950	36.3	224	1.67	n.a.	0.540	n.a.	26.17
1932	729083	1237	164164	n.a.	14.70	n.a.	844	36.0	225	1.70	n.a.	0.408	n.a.	23.44
1933	729503	1257	165208	n.a.	13.70	n.a.	777	35.2	226	1.72	n.a.	0.389	n.a.	22.07
1934	729922	1277	166253	n.a.	14.50	n.a.	830	36.2	228	1.75	n.a.	0.401	n.a.	22.93
1935	730342	1298	167298	n.a.	15.50	n.a.	870	36.5	229	1.78	n.a.	0.425	n.a.	23.84
1936	730761	1319	168343	n.a.	16.70	n.a.	896	37.4	230	1.80	n.a.	0.447	n.a.	23.96
1937	731180	1339	169387	n.a.	18.10	n.a.	965	37.2	232	1.83	n.a.	0.487	n.a.	25.94
1938	731600	1359	170432	n.a.	18.60	n.a.	956	39.8	233	1.86	n.a.	0.467	n.a.	24.02
1939	732019	1379	171477	n.a.	19.50	23.44	975	39.6	234	1.88	n.a.	0.492	0.59	24.62
1940	732439	1344	172521	1.84	23.30	24.94	1084	40.5	236	1.83	n.a.	0.575	0.62	26.77
*1941	732858	1224	173566	2.21	28.90	26.65	1220	41.7	237	1.67	0.053	0.693	0.64	29.26
1942	721881	1139	173614	2.75	37.40	28.62	1383	43.8	241	1.58	0.063	0.854	0.65	31.58
1943	710905	1118	173662	3.55	47.30	30.79	1526	44.8	244	1.57	0.079	1.056	0.69	34.06
1944	699928	1136	173710	3.80	48.60	31.85	1565	45.2	248	1.62	0.084	1.075	0.70	34.62
1945	688951	1144	173758	4.04	52.70	32.04	1538	44.0	252	1.66	0.092	1.198	0.73	34.95
1946	677975	1271	173807	4.37	55.60	32.48	1516	45.4	256	1.87	0.096	1.225	0.72	33.39
1947	666998	1172	173855	4.70	60.30	36.19	1712	48.3	261	1.76	0.097	1.248	0.75	35.45
1948	656021	1186	173903	5.05	65.60	40.06	1960	54.2	265	1.81	0.093	1.210	0.74	36.16
1949	645044	1114	173951	5.06	66.00	42.96	2067	60.6	270	1.73	0.083	1.089	0.71	34.11
1950	634068	1066	173999	4.98	65.10	45.08	2183	63.2	274	1.68	0.079	1.030	0.71	34.54



Table 2. Labour, Land, and Machinery in Agriculture, Canada, 1871-1981 (concluded)

Year Censuses year	Number of farms (1)	Number of individ. in agric. industry (,000) (2)	Land in agric. (,000 ac.) (1)	Average hired farm wage rate per day (without board)	Index of farm wage rates (1961 =100) (2)	Average indust. weekly wage rate (2)	Average annual earnings prodn. workers (2)	Farm mach. price index (1961 =100) (2)	Average acres per farm	Number of individ. in agric. per farm	Ratio of farm wages to mach. price index	Ratio of farm wage index to mach. price index	Ratio of indust. weekly wage to mach. price index	Ratio of annual earnings prodn. workers to mach. price index
*1951	623091	991	174047	5.70	73.60	50.04	2434	71.5	279	1.59	0.080	1.029	0.70	34.04
1952	613476	927	174022	6.15	78.70	54.41	2647	74.8	284	1.51	0.082	1.052	0.73	35.39
1953	603861	898	173998	6.30	79.30	57.53	2792	75.2	288	1.49	0.084	1.055	0.77	37.13
1954	594245	893	173973	6.10	78.00	59.04	2853	75.7	293	1.50	0.081	1.030	0.78	37.69
1955	584630	873	173949	6.23	77.70	61.05	2963	76.1	298	1.49	0.082	1.021	0.80	38.94
*1956	575015	819	173924	6.63	83.10	64.44	3136	80.1	302	1.42	0.083	1.037	0.80	39.15
1957	556193	772	173649	6.98	88.60	67.90	3276	85.6	312	1.39	0.082	1.035	0.79	38.27
1958	537370	739	173375	7.13	90.70	70.35	3400	90.6	323	1.38	0.079	1.001	0.78	37.53
1959	518548	724	173100	7.28	95.10	73.40	3557	95.0	334	1.40	0.077	1.001	0.77	37.44
1960	499725	675	172826	7.45	98.10	75.76	3669	97.2	346	1.35	0.077	1.009	0.78	37.75
*1961	480903	681	172551	7.65	100.00	78.24	3761	100.0	359	1.42	0.077	1.000	0.78	37.61
1962	470827	660	172866	7.75	101.90	80.54	3935	102.9	367	1.40	0.075	0.990	0.78	38.24
1963	460751	649	173181	8.05	105.30	83.27	4081	105.7	376	1.41	0.076	0.996	0.79	38.61
1964	450674	630	173495	8.40	109.50	86.51	4268	108.4	385	1.40	0.077	1.010	0.80	39.37
1965	440598	594	173810	8.98	118.50	91.01	4492	110.9	394	1.35	0.081	1.069	0.82	40.50
*1966	430522	544	174125	9.73	131.80	96.34	4753	114.6	404	1.26	0.085	1.150	0.84	41.47
1967	417643	559	173234	10.45	142.60	102.83	5022	118.0	415	1.34	0.089	1.208	0.87	42.56
1968	404764	546	172343	11.43	153.00	109.88	5411	121.6	426	1.35	0.094	1.258	0.90	44.50
1969	391886	535	171451	12.23	161.80	117.63	5817	124.6	438	1.37	0.098	1.299	0.94	46.69
1970	379007	511	170560	12.68	169.80	126.82	6197	128.0	450	1.35	0.099	1.327	0.99	48.41
*1971	366128	510	169669	13.23	178.20	137.64	6695	131.4	463	1.39	0.101	1.356	1.05	50.95
1972	360618	481	169552	14.48	190.60	149.22	7224	135.3	470	1.33	0.107	1.409	1.10	53.39
1973	355108	467	169436	16.33	216.10	160.22	7884	139.0	477	1.32	0.117	1.555	1.15	56.72
1974	349598	473	169319	19.10	254.00	178.09	8946	154.6	484	1.35	0.124	1.643	1.15	57.87
1975	344088	479	169203	22.41	284.40	203.34	9962	195.4	492	1.39	0.115	1.455	1.04	50.98
*1976	338578	472	169086	25.64	332.90	228.03	11439	208.0	499	1.39	0.123	1.600	1.10	55.00
1977	334535	464	167832	28.40	366.00	249.95	12732	222.0	502	1.39	0.128	1.649	1.13	57.35
1978	330491	474	166578	30.11	388.30	265.35	13684	244.5	504	1.43	0.123	1.588	1.09	55.97
1979	326448	484	165323	32.20	413.80	287.48	14973	277.9	506	1.48	0.116	1.489	1.03	53.88
1980	322404	479	164069	34.31	443.00	317.39	16536	316.2	509	1.49	0.109	1.401	1.00	52.30
*1981	318361	485	162815	36.80	487.70	355.78	17800	352.3	511	1.52	0.104	1.384	1.01	50.53

1) Source: Canada. Statistics Canada. Censuses of Agriculture, 1871 to 1981.

Data for inter-censal years are interpolated.

2) Source: Canada. Statistics Canada. Historical Statistics of Canada (2nd ed.) (Catalogue No. 11-516), with updates from sources cited therein.

Table 3. Average Annual Percent Changes in Land, Labour, and Machinery in Agriculture, Canada, 1921-1981

Year	Number of farms (1)	Number of individ. in agric. industry (,000) (2)	Land in agric. (,000 ac.) (1)	Average hired farm wage rate per day (without board)	Index of farm wage rates (1961 =100) (2)	Average indust. weekly wage rate (2)	Average annual earnings prodn. workers (2)	Farm mach. price index (1961 =100) (2)	Average acres per farm	Number of individ. in agric. per farm	Ratio of farm wages to mach. price index	Ratio of farm wage index to mach. price index	Ratio of indust. weekly wage to mach. price index	Ratio of annual earnings prodn. workers to mach. price index
DECADE AVERAGE ANNUAL PERCENT CHANGES														
1921-1931	.24	.46	1.48	.00	-4.57	.00	-.45	-1.32	1.23	.21	.00	-3.00	.00	1.29
1931-1941	.06	.12	.62	2.01	4.82	1.33	2.80	1.43	.56	.06	.00	3.27	.78	1.35
1941-1951	-1.61	-1.94	.03	10.31	10.21	6.57	7.31	5.66	1.66	-.34	4.68	4.57	.96	-1.63
1951-1961	-2.55	-3.65	-.09	3.03	3.15	4.59	4.46	3.44	2.54	-1.11	-.39	-.28	1.15	1.03
1961-1971	-2.69	-2.81	-.17	5.66	5.98	5.83	5.95	2.77	2.59	-.11	2.81	3.12	2.98	3.09
1971-1981	-1.39	-.47	-.41	10.85	10.66	9.99	10.30	10.55	.99	.93	.56	.45	-.25	.08
FIVE-YEAR AVERAGE ANNUAL PERCENT CHANGES														
1921-1926	.25	1.44	1.53	N/A	-2.06	N/A	.05	-2.10	1.28	1.19	N/A	.64	N/A	3.01
1926-1931	.24	-.53	1.42	N/A	-7.08	N/A	-.95	-.54	1.18	-.77	N/A	-6.65	N/A	-.43
1931-1936	.06	1.64	.63	N/A	-2.26	N/A	-.89	.62	.57	1.58	N/A	-3.00	N/A	-1.59
1936-1941	.06	-1.40	.61	4.02	11.90	2.65	6.50	2.24	.56	-1.45	N/A	9.54	1.56	4.28
1941-1946	-1.54	.93	.03	15.01	14.51	4.08	4.62	1.75	1.60	2.51	12.96	12.47	2.31	2.79
1946-1951	-1.67	-4.80	.03	5.61	5.91	9.06	10.00	9.57	1.73	-3.18	-3.60	-3.32	-.40	.46
1951-1956	-1.59	-3.71	-.01	3.14	2.52	5.21	5.22	2.32	1.60	-2.15	.78	.17	2.84	2.85
1956-1961	-3.51	-3.58	-.16	2.91	3.79	3.96	3.70	4.55	3.48	-.07	-1.55	-.72	-.55	-.79
1961-1966	-2.19	-4.36	.18	4.96	5.73	4.26	4.80	2.76	2.42	-2.22	2.13	2.89	1.45	1.98
1966-1971	-3.19	-1.25	-.52	6.36	6.23	7.40	7.10	2.77	2.76	2.00	3.49	3.36	4.50	4.21
1971-1976	-1.55	-1.50	-.07	14.19	13.38	10.65	11.34	9.95	1.51	.05	4.31	3.69	1.09	1.80
1976-1981	-1.22	.56	-.75	7.51	7.95	9.32	9.26	11.15	.48	1.80	-3.19	-2.80	-1.59	-1.64

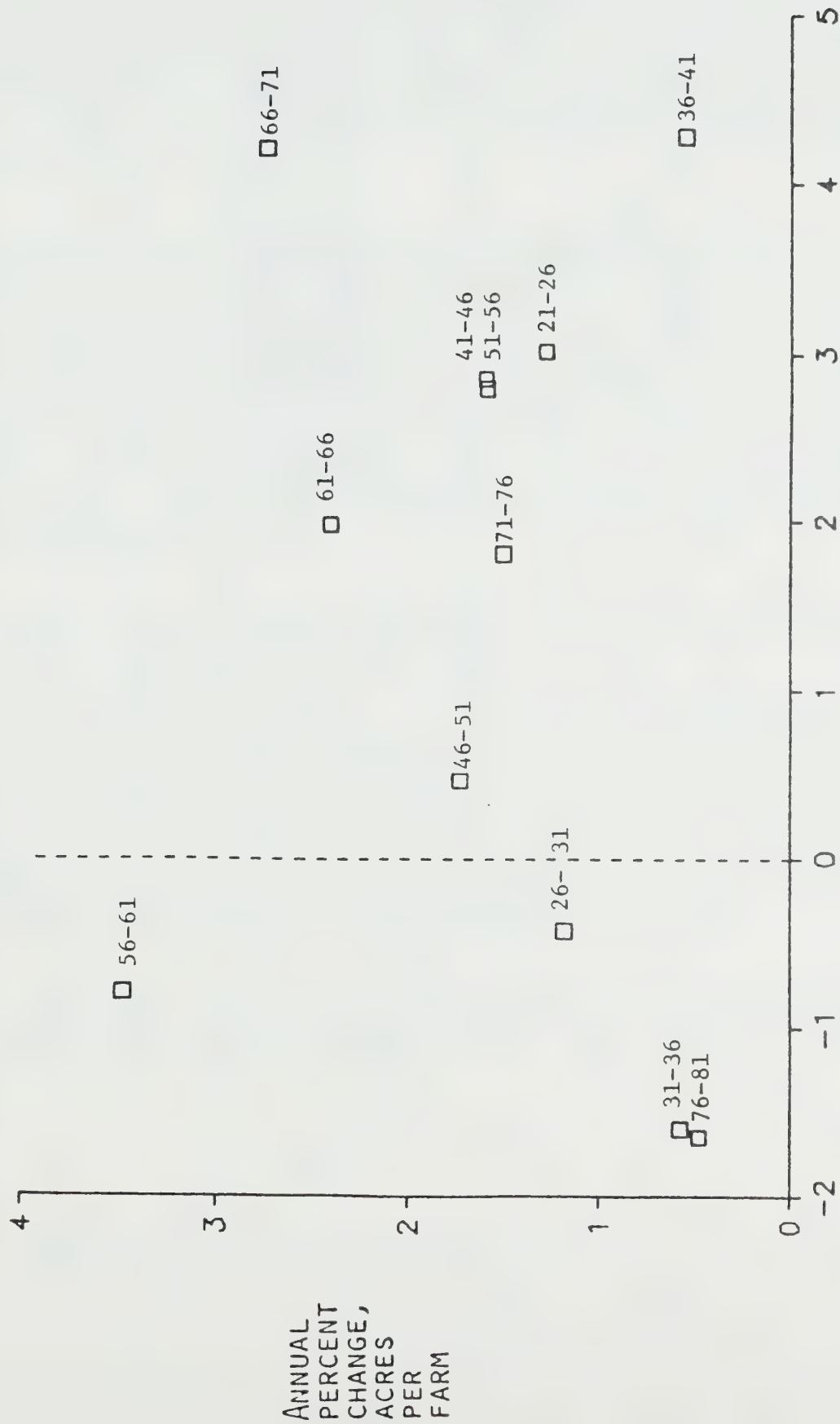
(1) Source: Canada. Statistics Canada. Censuses of Agriculture, 1871 to 1981.

Data for inter-censal years are interpolated.

(2) Source: Canada. Statistics Canada. Historical Statistics of Canada (2nd ed.) (Catalogue No. 11-516), with updates from sources cited therein.

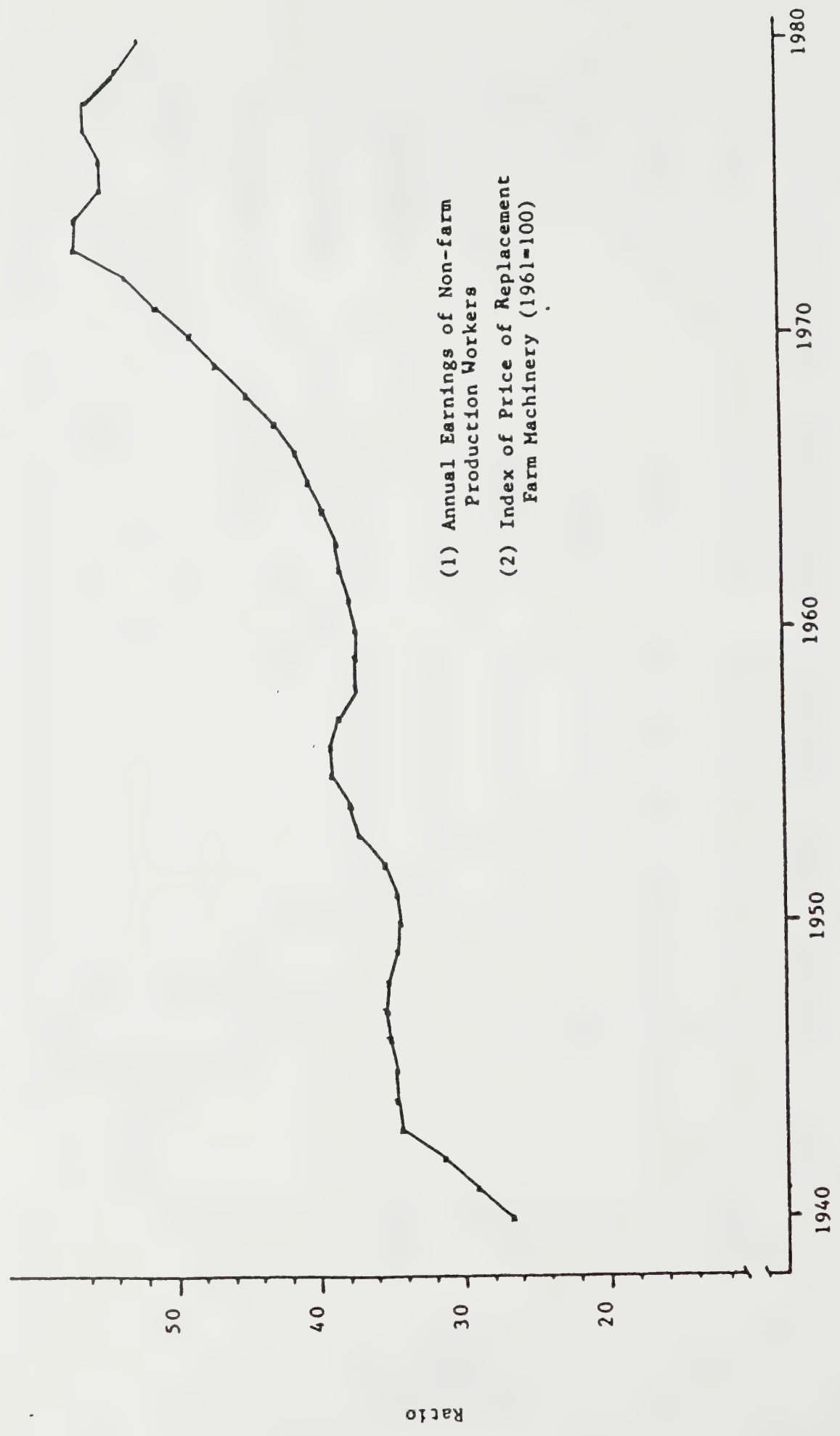


FIGURE 1 . PERCENT CHANGE IN ACRES PER FARM, CANADA, 1921-1981



ANNUAL PERCENT CHANGE, RATIO OF ANNUAL EARNINGS OF PRODUCTION WORKERS TO FARM MACHINERY PRICE INDEX

FIGURE 2 : RATIO OF PRICE OF LABOUR (1) TO PRICE OF FARM MACHINERY (2),  
CANADA, 1940 - 1980 (3-year moving median)



Source: Canada. Statistics Canada. Historical Statistics of Canada (Cat. No. 11-516).



## 2.2 Concentration of Farmland

There has always been concentration of farmland in Canadian agriculture. As early as 1901, 36 percent of the farmland was on 13 percent of the farms (over 200 acres) (Table 4 and Figure 3). In 1981, 49 percent of the farmland was on 12 percent of the farms (of 1120 acres or more). In 1981, one-third of the farmland was on farms with 10 or more quarter sections of land.

Historically, the number of farms with 1,120 acres of more has been increasing. The number of farms with 760 to 1,119 acres increased until 1971 and has been decreasing since that time. The number of farms with 560 to 759 acres increased until 1961 and has been decreasing thereafter. The number of small farms, as a whole, has been declining since 1951, but the number of farms under 10 acres was larger in 1981 than in any year since 1961. The fact that the number of large farms is increasing, the number of middle farms is decreasing and the number of small farms may be increasing suggests:

1. the idea of the disappearing middle exists in the distribution of farms in terms of acres per farm; and
2. the possibility of Kislev and Peterson's speculated decline in average farm size would require a reversal in some fundamental trends in the concentration of farmland. If average farm size would have been maintained during the 1971-1981 period by an increase in the number of farms under 10 acres, this would have implied that the number of such farms in the 1976-1981 period would have had to more than triple to a figure not seen in Canada since 1911.

To understand some of the fundamental trends in the concentration of farmland, we move to a consideration of the gross rates of structural change.

Table 4. Distribution of Farms and Farmland by Size of Farm (acres), Canada, 1901-1981

Year	Size class of total farm area (acres)							Total			
	1-4	5-10	11-50	51-100	101-200	201 +					
1901											
-number of farms	39240	18331	81243	156778	150826	64655	511073				
-percent of total	8	4	16	31	30	13	100				
-aggregate acres (,000)	78	128	2925	13796	23529	22965	63422				
-percent of total	0	0	5	22	37	36	100				
-average acres(2)	2	7	36	88	156	355	124				
1911											
-number of farms	44011	24416	89018	164173	227934	132777	682329				
-percent of total	6	4	13	24	33	19	100				
-aggregate acres (,000)	88	171	3205	14447	35558	55500	108969				
-percent of total	0	0	3	13	33	51	100				
-average acres(2)	2	7	36	88	156	418	160				
	1-4	5-10	11-50	51-100	101-200	201-299	300 +	Total			
1921											
-number of farms	21503	22555	82713	158292	229648	31482	164897	711090			
-percent of total	3	3	12	22	32	4	23	100			
-aggregate acres (,000)	48	168	2946	13867	35810	7649	80286	140774			
-percent of total	0	0	2	10	25	5	57	100			
-average acres	2	7	36	88	156	243	487	198			
	1-4	5-10	11-50	51-100	101-200	201-299	300-479	480-639	640 +	Total	
1931											
-number of farms	19713	24028	80070	148255	233306	35620	103247	36738	47646	728623	
-percent of total	3	3	11	20	32	5	14	5	7	100	
-aggregate acres (,000)	48	179	2768	12866	36284	8630	34531	18404	49403	163114	
-percent of total	0	0	2	8	22	5	21	11	30	100	
-average acres	2	7	35	87	156	242	334	501	1037	224	
1941											
-number of farms	11834	21605	77107	159159	230298	37632	103186	39186	52825	732832	
-percent of total	2	3	11	22	31	5	14	5	7	100	
-aggregate acres (,000)	30	162	2610	13647	35253	9026	34616	19656	58563	173563	
-percent of total	0	0	2	8	20	5	20	11	34	100	
-average acres	3	7	34	86	153	240	335	502	1109	237	
	under 3	3 - 9	10 - 69	70-239	240-399	400-559	560-759	760-1119	1120-1599	1600 +	Total
1951											
-number of farms(3)	2258	22446	83264	293872	102946	48192	30821	22665	9899	6728	623091
-percent of total	0	4	13	47	17	8	5	4	2	1	100
-aggregate acres (,000)	4	122	3045	39191	31548	22602	19677	19899	12476	25483	174047
-percent of total	0	0	2	23	18	13	11	11	7	15	100
-average acres	2	5	37	133	306	469	638	878	1260	3788	279
1956											
-number of farms(3)	2052	19415	75409	261799	93551	46997	31825	24959	11104	7904	575015
-percent of total	0	3	13	46	16	8	6	4	2	1	100
-aggregate acres (,000)	3	106	2806	35116	28690	22060	20335	21957	14064	28786	173924
-percent of total	0	0	2	20	16	13	12	13	8	17	100
-average acres	1	5	37	134	307	469	639	880	1267	3642	302
1961											
-number of farms	4620	12114	50449	204159	82626	44764	31860	27642	13091	9578	480903
-percent of total	1	3	10	42	17	9	7	6	3	2	100
-aggregate acres (,000)	8	65	1967	28419	25430	21026	20370	24438	16641	34185	172551
-percent of total	0	0	1	16	15	12	12	14	10	20	100
-average acres	2	5	39	139	308	470	639	884	1271	3569	359
1966											
-number of farms	4692	11518	44781	166893	73226	41095	31459	29824	15153	11881	430522
-percent of total	1	3	10	39	17	10	7	7	4	3	100
-aggregate acres (,000)	8	62	1687	23554	22526	19306	20153	26509	19376	40942	174125
-percent of total	0	0	1	14	13	11	12	15	11	24	100
-average acres	2	5	38	141	308	470	641	889	1279	3446	404
1971											
-number of farms	3988	10228	38611	127551	59867	35821	28970	29998	16753	14341	366128
-percent of total	1	3	11	35	16	10	8	8	5	4	100
-aggregate acres (,000)	6	55	1396	18211	18447	16828	18594	26799	21525	47805	169669
-percent of total	0	0	1	11	11	10	11	16	13	28	100
-average acres	2	5	36	143	308	470	642	893	1285	3333	463
1976											
-number of farms	3730	10365	40573	108965	52859	31571	26616	29513	17909	16451	338552
-percent of total	1	3	12	32	16	9	8	9	5	5	100
-aggregate acres (,000)	6	57	1416	15605	16296	14836	17099	26434	23068	54263	169082
-percent of total	0	0	1	9	10	9	10	16	14	32	100
-average acres	2	5	35	143	308	470	642	896	1288	3298	499
1981											
-number of farms	4760	11653	40301	99000	47081	27759	23758	27788	18283	17978	318361
-percent of total	1	4	13	31	15	9	7	9	6	6	100
-aggregate ac. (,000) (1)	6	64	1399	14161	14541	13055	15270	24970	23648	55700	162815
-percent of total	0	0	1	9	9	8	9	15	15	34	100
-average acres	1	5	35	143	309	470	643	899	1293	3098	511

Sources: Canada. Statistics Canada. Censuses of Agriculture, 1901-1981

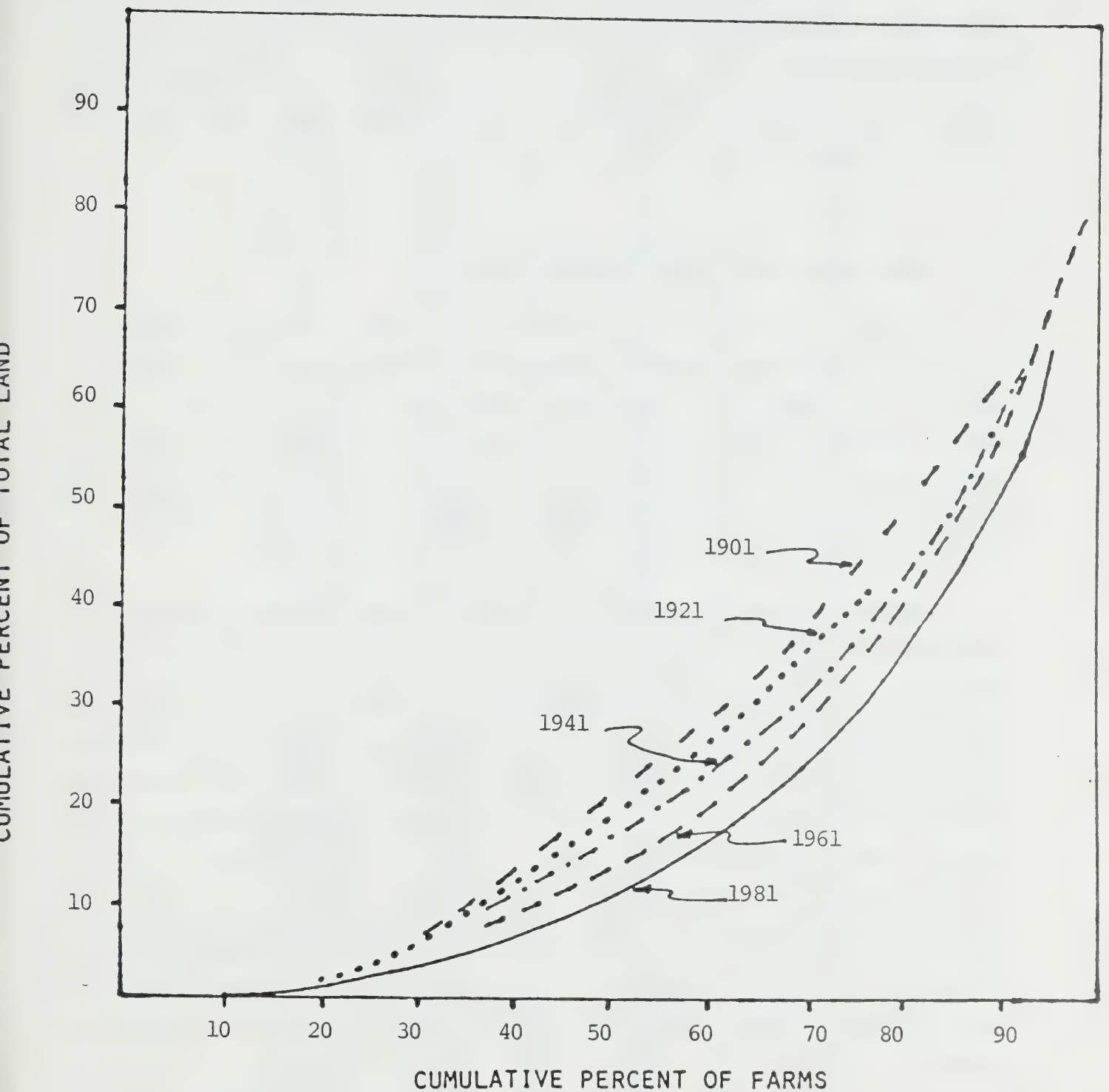
(1) Aggregate acres in 1981 were adjusted from the published numbers due to under-enumeration of unimproved land in the Western provinces. This adjustment is not reflected in this table although it may be expected that the under-enumerated unimproved land would have been on the larger farms.

(2) Average acres were assigned for all classes except the open-ended class. Aggregate acres were then calculated, and aggregate acres for the open-ended class were calculated as a residual. Then average acres for the open-ended class were calculated.

(3) In 1951 and 1956, holdings under 3 acres required sales of \$250 or more to be included as a census-farm.



FIGURE 3 . LORENZ CURVES SHOWING CONCENTRATION OF LAND  
ON FARMS, CANADA, 1901-1981.



SOURCE: CANADA, STATISTICS CANADA, CENSUSES OF AGRICULTURE,  
1901-1981.

### 3. Gross Rates of Structural Change

#### 3.1 Rates of Entry and Exit by Farm Size

Rates of entry and exit are largest for the smallest farms. Over a five-year period, about 40 percent of the operators of small farms (under 180 acres) will either start or stop operating their farm (Tables 5 and 6). Entry and exit rates were as low as 10 percent for operators of farms with 1,600 to 2,499 acres in the 1976-1981 period. In addition to high rates of entry and exit, there are significant gross flows among the size classes of farm size.

#### 3.2 Gross Flows Among Size Classes of Farm Size

Regardless of farm size in the beginning period, only 40 to 50 percent of census-farm operators remained in the same size class five years later (except for the largest open-ended class) (Table 7). As we have seen above, entry and exit rates are considerably lower among the larger farms. Most of the gross flows among size classes are to the next nearest size class. Six to 14 percent expand to the next largest size class and about 8 to 16 percent fall back one size class.

The data on gross flows facilitates the calculation of a transition probability matrix and the preparation of projections of farm numbers by acre size classes using a simple Markov chain. Two projections are presented (summarized in Table 8 and Figure 4). Projection "a" uses the average transition probability matrix calculated over the three periods of observation (1966 to 1971, 1971 to 1976, and 1976 to 1981). The resulting decline in farm numbers of -9 percent seems unrealistically high given the recent 5-year declines in farm numbers (Table 1) and the recent reversal in the labour/machinery price ratio (Figure 2). Projection "b" uses only the 1976-1981 period and provides a decline in farm numbers of -6 percent. This seems more realistic. Surprisingly, the simple Markov chain does not continue to project an increase in the number of farms in the 1,120-1,559 acres class. Perhaps the peak in farm numbers in this class has been reached.

Table 5. Rate of Entry of Census-farm Operators, by Size of Total Farm Area(acres), Canada, 1946-1951 and 1966-1981

Size class of total farm area (acres)	Operators at end of period		Entering operators		Rate of entry (%)
	Number	Percent	Number	Percent	
	(1951)		(1946-1951)		
1-239	400498	64	101916	68	25
240-399	102612	17	24879	17	24
400-759	78762	13	16783	11	21
760-1119	22597	4	4172	3	18
1120-1599	9873	2	1663	1	17
1600 +	6674	1	1110	1	17
Total	621016	100	150523	100	24
	(1971)		(1966-1971)		
1-180	153030	42	49855	57	33
181-399	86975	24	18145	21	21
400-759	64710	18	11555	13	18
760-1119	29960	8	4410	5	15
1120-1599	16715	5	2050	2	12
1600-2499	9145	3	1155	1	13
2500 +	4800	1	785	1	16
Total	365335	100	87955	100	24
	(1976)		(1971-1976)		
1-180	140520	42	57095	56	41
181-399	75770	22	19665	19	26
400-759	58110	17	13775	13	24
760-1119	29470	9	5745	6	19
1120-1599	17875	5	3185	3	18
1600-2499	10355	3	1770	2	17
2500 +	5675	2	1125	1	20
Total	337775	100	102365	100	30
	(1981)		(1976-1981)		
1-180	135360	43	50980	63	38
181-399	67280	21	13360	17	20
400-759	51465	16	8560	11	17
760-1119	27750	9	3530	4	13
1120-1599	18255	6	2000	2	11
1600-2499	11565	4	1130	1	10
2500 +	6075	2	740	1	12
Total	317755	100	80305	100	25

Source: Canada. Statistics Canada. 1966 to 1981  
Census of Agriculture Match



Table 6. Rate of Exit of Census-farm Operators,  
by Size of Total Farm Area(acres), Canada, 1966-1981

Size class of total farm area (acres)	Operators at beginning of period		Exiting operators		Rate of exit ( % )
	Number	Percent	Number	Percent	
	(1966)		(1966-1971)		
1-180	193960	45	88810	58	46
181-399	106880	25	35110	23	33
400-759	72470	17	18015	12	25
760-1119	29785	7	5785	4	19
1120-1599	15120	4	2555	2	17
1600-2499	7580	2	1290	1	17
2500 +	3935	1	800	1	20
Total	429730	100	152355	100	35
	(1971)		(1971-1976)		
1-180	153030	42	69740	54	46
181-399	86980	24	29235	23	34
400-759	64710	18	18130	14	28
760-1119	29955	8	6775	5	23
1120-1599	16715	5	3265	3	20
1600-2499	9145	3	1745	1	19
2500 +	4800	1	1030	1	21
Total	365335	100	129925	100	36
	(1976)		(1976-1981)		
1-180	135360	43	50980	63	38
181-399	67280	21	13360	17	20
400-759	51465	16	8560	11	17
760-1119	27750	9	3530	4	13
1120-1599	18255	6	2000	2	11
1600-2499	11565	4	1130	1	10
2500 +	6075	2	740	1	12
Total	317755	100	80305	100	25

Source: Canada. Statistics Canada. 1966 to 1981  
Census of Agriculture Match

Table 7. Gross Flows of Census-farm Operators(1) Among Size Classes of Total Area (acres), Canada, 1966- 1981

Size class of total farm area(acres) at beginning of period	Period	Total at beginning of period	Size class of total farm area(acres) at end of period							Exiters
			1 to 180	181 to 399	400 to 759	760 to 1119	1120 to 1599	1600 to 2499	2500 or over	
1-180	1966-1971	193960	89750	12490	2165	470	180	65	35	88810
	1971-1976	153030	70775	9945	1875	415	165	80	30	69740
	1976-1981	140520	70870	8170	1835	460	190	85	40	58855
181-399	1966-1971	106880	10650	49210	9830	1440	430	145	65	35110
	1971-1976	86980	9270	38690	7870	1290	420	150	55	29235
	1976-1981	75770	9355	37680	6855	1220	450	190	55	19965
400-759	1966-1971	72470	2130	6085	36085	7445	2025	550	135	18015
	1971-1976	64710	2420	6070	29040	6425	1940	555	125	18130
	1976-1981	58105	2915	6415	27965	5680	1875	635	190	12430
760-1119	1966-1971	29785	410	745	4010	13660	3975	1005	195	5785
	1971-1976	29955	585	950	4135	12355	3860	1090	200	6775
	1976-1981	29465	750	1075	4530	13140	3930	1195	220	4635
1120-1599	1966-1971	15120	140	215	810	2070	6920	2110	305	2555
	1971-1976	16715	220	285	1065	2525	6785	2230	350	3265
	1976-1981	17875	315	360	1175	2885	7875	2470	430	2370
1600-2499	1966-1971	7580	65	70	205	395	1020	3730	805	1290
	1971-1976	9145	120	125	265	615	1315	3985	970	1745
	1976-1981	10355	120	160	400	675	1660	5060	1060	1225
2500 +	1966-1971	3935	15	25	50	70	120	385	2475	800
	1971-1976	4800	40	40	80	95	205	495	2815	1030
	1976-1981	5675	60	60	145	165	270	800	3340	830
Continuing Operators (subtotal)	1966-1971	277375	103170	68835	53155	25545	14665	7995	4015	
	1971-1976	235410	83420	56110	44330	23725	14690	8585	4550	
	1976-1981	237460	84380	53920	42905	24220	16260	10435	5335	
Entrants	1966-1971	87955	49855	18145	11555	4410	2050	1155	785	
	1971-1976	102365	57095	19665	13775	5745	3185	1770	1125	
	1976-1981	80305	50908	13360	8560	3530	2000	1130	740	

Table 7. Gross Flows of Census-farm Operators(1) Among Size Classes of Total Farm Area (acres), Canada, 1966- 1981 (continued)

Size class of total farm area(acres) at beginning of period	Period	Total at beginning of period	Size class of total farm area(acres) at end of period							
			1	181	400	760	1120	1600	2500	Exiters
			to 180	to 399	to 759	to 1119	to 1599	to 2499	or over	
gross flows as proportion of number in class at beginning of period (transition probability matrices)										
1-180	1966-1971	1	0.463	0.064	0.011	0.002	0.001	0.000	0.000	0.458
	1971-1976	1	0.462	0.065	0.012	0.003	0.001	0.001	0.000	0.456
	1976-1981	1	0.504	0.058	0.013	0.003	0.001	0.001	0.000	0.419
	average	1	0.477	0.063	0.012	0.003	0.001	0.000	0.000	0.444
181-399	1966-1971	1	0.100	0.460	0.092	0.013	0.004	0.001	0.001	0.328
	1971-1976	1	0.107	0.445	0.090	0.015	0.005	0.002	0.001	0.336
	1976-1981	1	0.123	0.497	0.090	0.016	0.006	0.003	0.001	0.263
	average	1	0.110	0.468	0.091	0.015	0.005	0.002	0.001	0.309
400-759	1966-1971	1	0.029	0.084	0.498	0.103	0.028	0.008	0.002	0.249
	1971-1976	1	0.037	0.094	0.449	0.099	0.030	0.009	0.002	0.280
	1976-1981	1	0.050	0.110	0.481	0.098	0.032	0.011	0.003	0.214
	average	1	0.039	0.096	0.476	0.100	0.030	0.009	0.002	0.248
760-1119	1966-1971	1	0.014	0.025	0.135	0.459	0.133	0.034	0.007	0.194
	1971-1976	1	0.020	0.032	0.138	0.412	0.129	0.036	0.007	0.226
	1976-1981	1	0.025	0.036	0.154	0.446	0.133	0.041	0.007	0.157
	average	1	0.020	0.031	0.142	0.439	0.132	0.037	0.007	0.193
1120-1599	1966-1971	1	0.009	0.014	0.054	0.137	0.458	0.140	0.020	0.169
	1971-1976	1	0.013	0.017	0.064	0.151	0.406	0.133	0.021	0.195
	1976-1981	1	0.018	0.020	0.066	0.161	0.441	0.138	0.024	0.133
	average	1	0.013	0.017	0.061	0.150	0.435	0.137	0.022	0.166
1600-2499	1966-1971	1	0.009	0.009	0.027	0.052	0.135	0.492	0.106	0.170
	1971-1976	1	0.013	0.014	0.029	0.067	0.144	0.436	0.106	0.191
	1976-1981	1	0.012	0.015	0.039	0.065	0.160	0.489	0.102	0.118
	average	1	0.011	0.013	0.032	0.062	0.146	0.472	0.105	0.160
2500 +	1966-1971	1	0.004	0.006	0.013	0.018	0.030	0.098	0.629	0.203
	1971-1976	1	0.008	0.008	0.017	0.020	0.043	0.103	0.586	0.215
	1976-1981	1	0.011	0.011	0.026	0.029	0.048	0.141	0.589	0.146
	average	1	0.008	0.008	0.018	0.022	0.040	0.114	0.601	0.188
entrants as proportion of continuing farmers										
entrants	1966-1971	0.317	0.483	0.264	0.217	0.173	0.140	0.144	0.196	
	1971-1976	0.435	0.684	0.350	0.311	0.242	0.217	0.206	0.247	
	1976-1981	0.338	0.603	0.248	0.200	0.146	0.123	0.108	0.139	
	average	0.363	0.590	0.287	0.243	0.187	0.160	0.153	0.194	



Table 7. Gross Flows of Census-farm Operators(1) Among Size Classes of Total Farm Area (acres), Canada, 1966- 1981 (concluded)

Size class of total farm area(acres) at beginning of period	Period	Total at beginning of period	Size class of total farm area(acres) at end of period							Exiters
			1 to 180	181 to 399	400 to 759	760 to 1119	1120 to 1599	1600 to 2499	2500 or over	
calculation of 1986 distribution of farms by size class of total farm area(acres) (using average transition probability matrice and average entry rate)										
1-180	1981-1986	135360	64502	8461	1646	379	152	66	30	60120
181-399	1981-1986	67280	7394	31454	6121	996	332	125	44	20814
400-759	1981-1986	51465	2006	4944	24497	5143	1547	465	121	12741
760-1119	1981-1986	27750	543	862	3944	12182	3660	1024	191	5344
1120-1599	1981-1986	18255	244	313	1114	2734	7936	2502	397	3024
1600-2499	1981-1986	11565	128	148	365	711	1691	5461	1213	1848
2500 or over	1981-1986	6075	46	51	111	135	245	692	3653	1142
stayers	1981-1986		74863	46233	37798	22281	15562	10335	5649	105032
entrants	1981-1986	75970	44194	13282	9168	4163	2488	1581	1095	
TOTAL	1986	288691	119057	59515	46965	26444	18050	11916	6744	
calculation of 1986 distribution of farms by size class of total farm area(acres) (using 1976-1981 transition probability matrice and 1976-1981 entry rate)										
1-180	1981-1986	135360	68268	7870	1768	443	183	82	39	56694
181-399	1981-1986	67280	8307	33458	6087	1083	400	169	49	17728
400-759	1981-1986	51465	2582	5682	24769	5031	1661	562	168	11010
760-1119	1981-1986	27750	706	1012	4266	12375	3701	1125	207	4365
1120-1599	1981-1986	18255	322	368	1200	2946	8042	2523	439	2420
1600-2499	1981-1986	11565	134	179	447	754	1854	5651	1184	1368
2500 or over	1981-1986	6075	64	64	155	177	289	856	3575	889
stayers	1981-1986		80383	48633	38692	22809	16130	10969	5661	94474
entrants	1981-1986	75547	48496	12050	7719	3324	1984	1188	785	
TOTAL	1986	298824	128879	60683	46412	26134	18114	12156	6447	

Source: Canada. Statistics Canada. 1966 to 1981 Census of Agriculture Match

(1) Operators of institutional farms, community pastures, and farms in the Yukon and Northwest Territories are excluded.

TABLE 8: Number of Census-farms<sup>(1)</sup> by Size Class of Farm Size (acres), 1966-1981 and Two Projections to 1986, Canada

Year	Size Class of Total Farm Area (acres)							Total
	1 - 180	181 - 399	400 - 759	760 - 1,119	1,120 - 1,599	1,600 - 2,499	2,500 or Over	
1966	193,960	106,880	72,470	29,785	15,120	7,580	3,935	429,730
1971	153,030	86,980	64,710	29,955	16,175	9,145	4,800	364,795
1976	140,520	75,770	58,105	29,465	17,875	10,355	5,675	337,765
1981	135,360	67,280	51,465	27,750	18,255	11,565	6,075	317,750
1986 <sup>(a)</sup>	119,057	59,515	46,965	26,444	18,050	11,916	6,744	288,691
1986 <sup>(b)</sup>	128,879	60,683	46,412	26,134	18,114	12,156	6,447	298,824

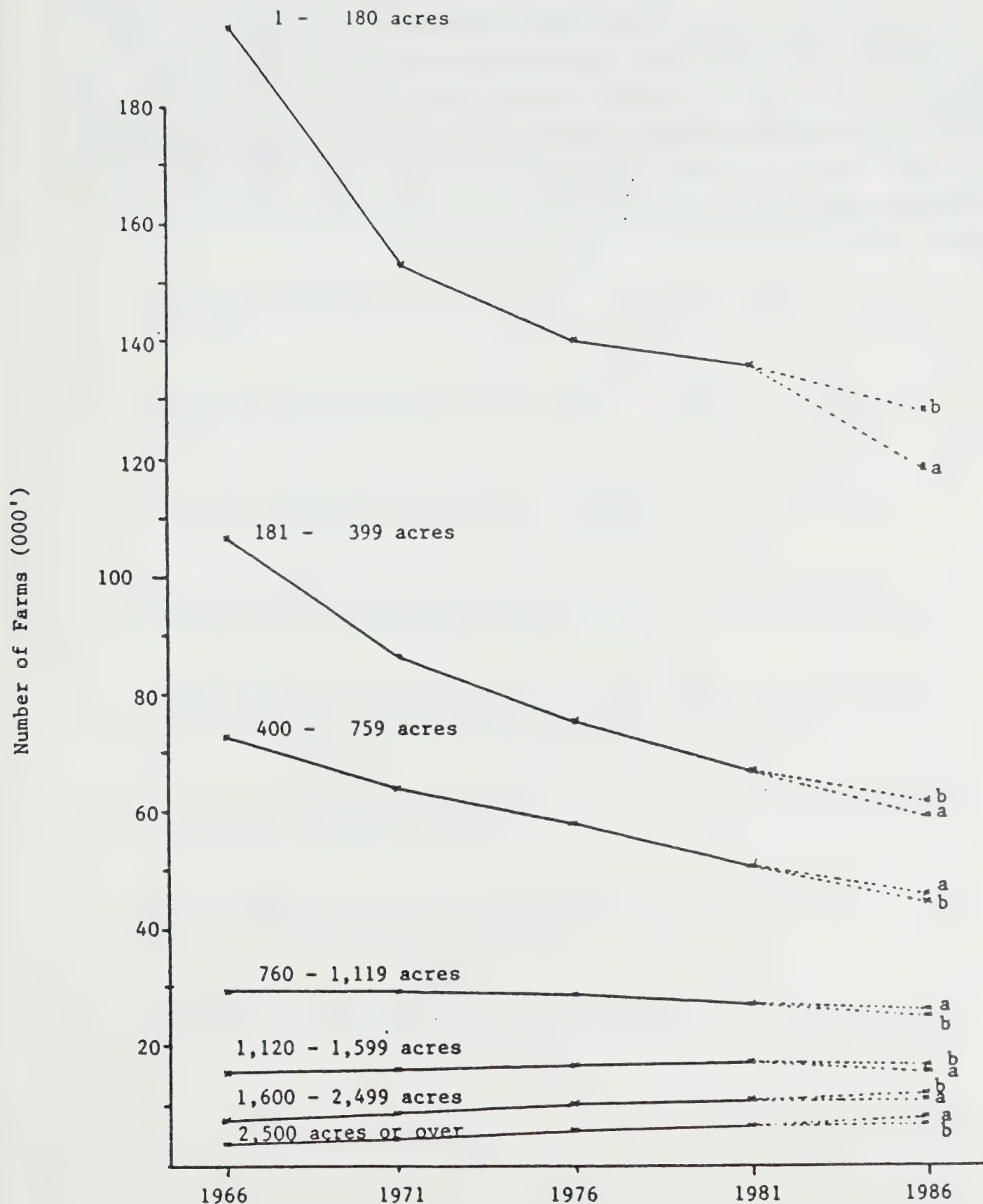
Source: Canada. Statistics Canada. 1986 to 1981 Census of Agriculture Match.

(1) Institutional farms and community pastures are excluded.

(a) Projection based on an average transition probability matrix calculated from the three periods of observation (namely, 1966 to 1971, 1971 to 1976, and 1976 to 1981). Entry rates were calculated as the observed number of entrants divided by the number of continuing operators in a given size class.

(b) Projection based on the 1976-1981 transition probability matrix.

FIGURE 4 : NUMBER OF FARMS BY FARM SIZE, 1966 - 1981, AND PROJECTED TO 1986, CANADA





#### 4. Summary and Conclusions

Average land area per farm is one component of the structure of agriculture that is an important issue in both developing and developed countries. A reversal in the rate of change in labour costs versus machinery costs in the last half of the 1970's helps to explain the decline in the rate of growth of farm size over this period in Canada. A simple Markov chain using 1976-1981 transition probability data appears more realistic than using data for the entire 1966 to 1981 period.

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